

ATTACHMENT I

Review of

Diesel Generator Alarm and Control Circuitry

Indian Point Units No. 2 and 3

Docket Nos. 50-247 and 50-286

May, 1977

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Question (a) Identify all conditions that render the diesel generator incapable of responding to an automatic emergency start signal.

Answer (a) There are six electrical contacts each of which when energized, will activate a diesel generator lock-out relay. This lock-out relay will in turn, cause a diesel to shutdown if it is operating or will prevent the diesel from responding to an automatic emergency start signal. These contacts are caused to energize by one of the following conditions:

- (i) Activation of the diesel emergency stop push-button in the diesel generator building.
- (ii) Activation of the over current relay. A phase to phase fault or excessive loads on the diesel generator will cause this relay to energize.
- (iii) Activation of the reverse power relay.
- (iv) Activation of the over crank relay. If a diesel engine fails to attain speed within 37 seconds, this relay will be energized.
- (v) Activation of the over speed relay. When the mechanical governor senses 1050 rpm, this relay will be energized.
- (vi) Activation of the low oil pressure relay. This relay is energized by the coincident sensing of lube oil pressure below 60 psi, by two of the three oil pressure switches on the diesel. An

oil pressure timer sets to allow 20 seconds to pass before tripping the diesel engine lock-out relay. This circuit is designed to provide sufficient time for the oil pressure to build up following an engine start. In addition, separate circuitry will also cause the diesel stop solenoid to energize after a 20 second delay if a single low oil pressure switch is activated.

A safety injection signal will prevent the first three conditions from energizing the diesel engine lock-out relay and tripping the diesel generator. Activation of any one of the latter three relays will still cause a diesel to stop even with the presence of a safety injection signal.

Once any of these six electrical contacts has been activated causing the diesel engine lock-out relay to energize, this lock-out relay requires a manual reset before the diesel may be started. Failure to reset this relay could prevent a diesel from starting when required to do so. In addition, an automatic diesel start may be prevented by the diesel engine control switch being in either the manual or off position rather than the automatic position.

There are a number of other mechanical or electrical conditions which when detected, will not cause a diesel trip or lock-out the automatic starting circuitry. These conditions, however, could potentially cause a diesel to fail to start or maintain speed. These conditions

are as follows:

- (i) insufficient fuel oil
- (ii) insufficient start air pressure
- (iii) clogging of the lube oil strainer or filter
- (iv) clogging of the fuel oil filters
- (v) loss of DC control circuit voltage
- (vi) loss of cooling water to the diesel jackets  
or lube oil

Finally, even if a diesel starts and operates correctly following an emergency start signal, they will not supply power to 480 volt buses if the breakers are in an open position.

Question (b) State the wording on the annunciator window in the control room that is alarmed for each of the conditions identified in (a).

Answer (b) Activation of the relays, excluding the emergency stop push button, which will cause the lock-out relay to energize, is alarmed locally in the diesel generator building. In addition, the mechanical or electrical faults which could contribute to the failure of a diesel generator are also alarmed in this building. The wording on these alarms is as follows:

- (i) Low Oil Pressure (energized on low lube oil pressure)
- (ii) Diff Fuel Strainer, Secondary, (energized on high differential pressure across the secondary strainer)
- (iii) Overcrank (energized on failure of engine to start)
- (iv) Hi Diff Press Lube Oil Strainer (energized on high differential pressure in the lube oil strainer)
- (v) High Water Temp (energized on high jacket water temperature)
- (vi) Diff Pressure Lube Oil Filter (energized on high differential pressure across the lube oil filter)
- (vii) Hi Hi Water Temp (energized on high high jacket water temperature)

- (viii) Battery Transfer (energized on loss of primary control circuit voltage and subsequent transfer to secondary control circuits) Note: this alarm is only applicable to Indian Point Unit No. 2.
- (ix) Overspeed (energized on diesel trip due to over-speed)
- (x) Overcurrent (energized on overcurrent trip of diesel generators)
- (xi) Low Fuel Oil Level, Day Tank (energized on low level in any one of the three fuel oil day tanks)
- (xii) Reverse Power (energized on diesel trip due to reverse power)
- (xiii) Low Start Air Pressure (energized on low starting air pressure)
- (xiv) Exciter Field Shutdown (energized when voltage shutdown pushbutton is activated)
- (xv) High Lube Oil Temp (energized on high lube oil temperature out of the engine)
- (xvi) Differential Pressure Primary Filter (energized on high differential pressure scross the primary fuel filter)
- (xvii) Service Water Cooling Low Flow (energized on low service water cooling flow) Note: this alarm is only applicable to Indian Point Unit No. 3

The generation of any one of these alarms in the diesel generator building will also cause a category alarm, Diesel Gen. Trouble, to be activated on the electrical annunciator panel in the Central

Control Room. A second alarm on this panel, Diesel Gen. Oil Storage Tank Low Level, will be energized on low level on any one of the three fuel oil storage tanks.

Activation of the emergency stop push button in the diesel generator building without the existence of a safety injection signal, or the activation of a single low lube oil pressure switch, will cause the diesel to trip. Either of these two situations, however, will energize one or more of the local alarms in the diesel generator building as well as Diesel Generator Trouble category alarm in the Central Control Room.

The alarm, Safeguards Equipment Locked Open, located on the safeguards annunciator panel in the Central Control Room, will energize in Indian Point Unit No. 2, if any of the eight switches for diesel generator breakers EG1, EG2A, EG2B, and EG3, is in a "pull out" position. In the Indian Point Unit No. 3 Control Room, this alarm will energize if diesel generator breakers EG1, EG2, or EG3, are in the "pull out" position. In addition, this alarm will energize at either Indian Point Unit No. 2 or 3 if any one of the three diesel engine control switches for that Unit is in other than the "automatic" position.

Question (c) Name any other alarm signals that also cause the same annunciator to alarm.

Answer (c) The following control switches in a "pull out" position will also cause the Safeguards Equipment Locked Open annunciator in the Indian Point Unit No. 2 Control Room, to alarm:

- (i) Safety Injection Pump Nos. 21, 22A feed, 22B feed, and 23
- (ii) RHR Pump Nos. 21 or 22
- (iii) Containment Spray Pump Nos. 21 or 22
- (iv) Service Water Pump Nos. 21, 22A feed, 22B feed, 23, 24, 25A feed, 25B feed, or 26.
- (v) Recirculation Fan Nos. 21, 22, 23, 24, or 25
- (vi) Auxillary Boiler Feed Pump Nos. 21 or 23
- (vii) Motor Control Centers 26A or 26B feeds
- (viii) 480 Volt Feed to Buses 2A, 3A, 5A, or 6A

The following control switches in a "pull out" position will also cause the Safeguards Equipment Locked Open annunciator in the Indian Point Unit No. 3 Control Room, to alarm:

- (i) Safety Injection Pump Nos. 31, 32 and 33
- (ii) RHR Pump Nos. 31 or 32
- (iii) Containment Spray Pump Nos. 31 or 32
- (iv) Service Water Pump Nos. 31, 32, 33, 34, 35 or 36

- (v) Recirculation Fan Nos. 31, 32, 33, 34,  
or 35
- (vi) Auxillary Boiler Feed Pump Nos. 31 or 33
- (vii) Motor Control Centers 36A or 36B, or  
36C feeds
- (viii) 480 Volt Tie Breaker 2A/3A
- (ix) 480 Volt Feed to Buses 2A, 3A, 5A, or 6A

Question (d) Identify any condition that renders the diesel generator incapable responding to an automatic emergency start signal which is not alarmed in the control room.

Answer (d) The failure to manually reset the diesel engine lock-out relay could potentially prevent an automatic emergency start of the diesels at a later time. This condition is not alarmed in the Control Room.

Loss of normal DC power to the diesel control circuits is alarmed locally and in the Central Control Room for Indian Point Unit No. 2. The unitized design for the D.C power supplies to the Indian Point Unit No. 3 diesels includes no such alarm.

A loss of DC power to a diesel at Indian Point Unit No. 3, therefore, could potentially not be alarmed.

Question (e) Explain any proposed modifications resulting from this evaluation.

Answer (e) It is proposed that three alarms be installed on the annunciator panels for both Indian Point Units No. 2 and 3. One alarm would be provided for each diesel. Each alarm would energize if the diesel stop solenoid has been activated by that diesel's lock-out relay. Thus, the diesel engine that has been tripped or prevented from starting by the activation of its stop solenoid will be identified in the Unit's Central Control Room. If the lock-out relay is not reset, this alarm would remain energized, identifying the problem to the control room operators. In addition, at Indian Point Unit No. 3, modifications will be made such that a loss of D.C. control power will also cause these proposed alarms to energize.